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FDI AND ECONOMIC GROWTH, A VECTOR AUTOREGRESSIONS ANALYSIS

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Abstract: Some empirical literature on the impact of FDI on growth provides contrasting results not only about the existence of a significant link between foreign direct investment and growth rates, but also about the sign of such relationship. The focus of this study is to analyze determinants of FDI in Indonesia from 1980 to 2016. The research using vector autoregressions/VAR methods. VAR is a statistical model used to capture the linear interdependencies among multiple time series. VAR models generalize the univariate autoregression (AR) models by allowing for more than one evolving variable. All variables in a VAR are treated symmetrically in a structural sense. Some of the variables used in the article include economic growth, investment growth, export growth, import growth and interest rate growth. The research concludes that the growth of FDI and export growth will drive an economic growth in Indonesia. FDI is believed to be a major impact on the pattern of international trade and the majority of investment into developing countries. Export is an important factor to stimulating the economic growth of a country as it will increase the capacity of the country to increase world output.

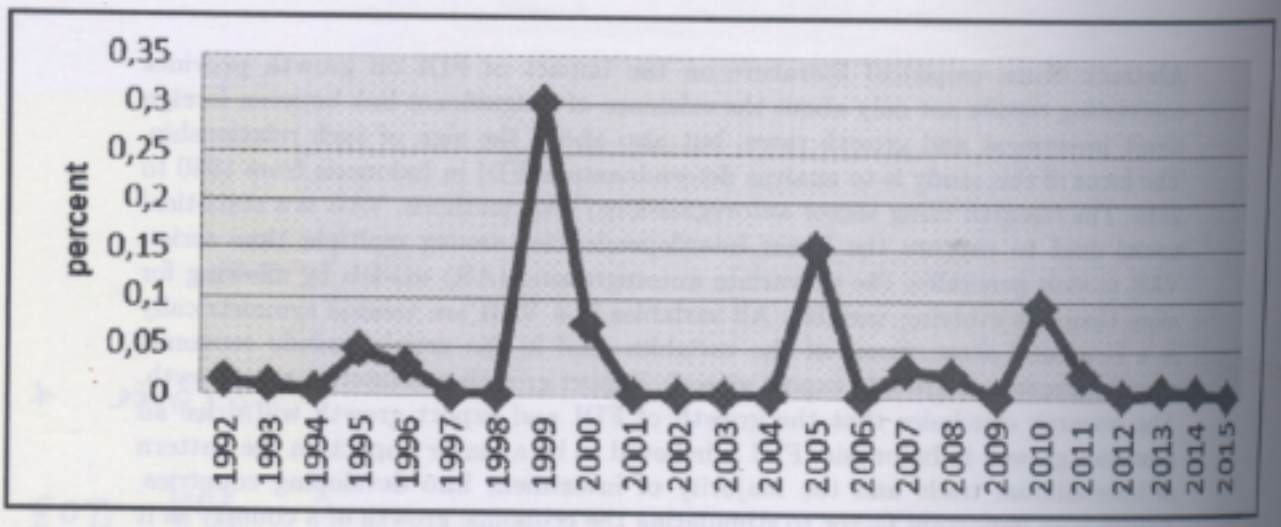
Introduction

Since 1970 redefinition of economic development have been occured. In new paradigm, the main purpose of economic development efforts not only increasing GDP growth, but also eliminate or reduction of poverty, inequality and unemployment in the context of a growing economy (Todaro and Smith (2006), Economic growth is the increase in the amount of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real gross domestic product, or real GDP. Growth is usually calculated in real terms, in order to obviate the distorting effect of inflation on the price of the goods produced. In economics, economic growth or economic growth theory typically refers to growth of potential output. As an area of study, economic growth is generally distinguished from development economics. The former is primarily the study of how countries can advance their economies. The latter is the study of the economic aspects of the development process in low-income countries. Since economic growth is measured as the annual percent change of gross domestic product (GDP), it has all the advantages and drawbacks of that measure. Economic growth is the increase in the amount of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real gross domestic product, or real GDP.

Economic growth is marked by changes in national income. In the economic theory of development is known that the rate of economic growth and investment

Keywords: foreign direct investment, economic growth, vector auto regression.

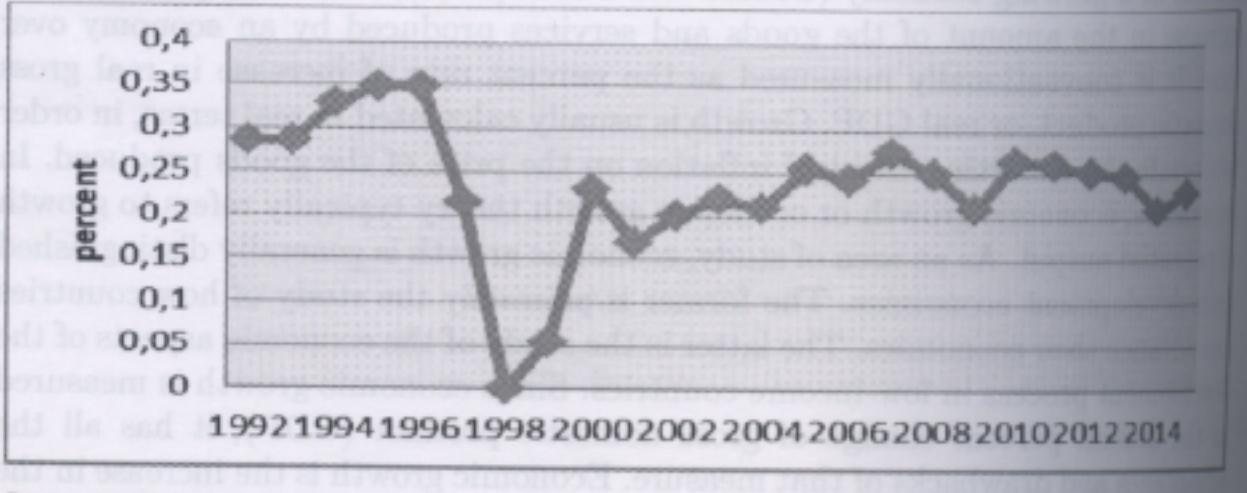
have a positive reciprocal relationship. Reciprocity occurs because the higher the economic growth of a country, the greater part of the revenue to be saved, so that the investment will increased. In this case, the investment is a function of economic growth. On the other hand, the larger a country's investment, both foreign and domestic, greater the rate of economic growth can be achieved (see Yao, 2006; Nwaogu and Ryan, 2015).



Sources: BKPM (2016)

Figure 1: FDI in Indonesia, 1992-2015

Data on investment growth in Indonesia can be seen in Figure 1. Investment in Indonesia, both foreign and domestic shows fluctuating conditions. Before the economic crisis, Indonesia's investment conditions showed an increasing trend. The condition is reversed during the economic crisis of 1998 that investment in Indonesia decline further.



Source: IMF (2012)

Figure 2: GDP Indonesia 1992 – 2015

Different with investments which had reached a negative number, the rate of growth of national income in Indonesia showed an increasing trend before economic crisis (see Figure 2). After the 1998 crisis the Indonesian economy has improved and stabilized until 2015. Investment is believed to be one of the factors that can

promote economic growth. Policy implications of the reciprocal relationship between the level of investment and the income level is on making projections for annual investment and economic growth.

Theoretically there are three main factors that influence a person's decision to invest. First, revenues, the extent to which he will earn sufficient income from capital embedded. Second, the cost, which is mainly determined by the level of interest rates and taxes, although the operation is determined by various other costs encountered in the field. Third, expectations, how to hope in the future of their investment. Thus, a serious investor in direct investment is not only hit and run, but also counting ahead. He takes into account the situations in the future that may affect its investment, including changes in the political situation (Hamid, 2008).

There are many research between investment in economic growth. Study by Gani and Din (2006) in Pakistan and Akhmetova, *et al* (2010) who conducted a study in Kazakhstan, said the investment does not have a significant effect on economic growth. Meanwhile, a study by Rao (2004) analyzed the correlation between the growth rate of investment to output ratio in the country of Fiji is concluded the results that increasing economic growth will boost investment. These findings are similar to a study conducted by the Gharana and Adhikari (2010) using Toda-Yamamoto-Dolado-Lutkephol Augmented VAR Granger Causality Testing Technique for explaining the strong correlation between investment growth in China. Borensztein, *et al* (1998) and Effendi and Soemantri (2003) which states that the presence of foreign direct investment actually increase economic growth. This finding is supported by Alfaro, *et al.* (2000) also stated that foreign direct investment has a positive impact on economic growth, especially in the financial sector.

Several previous studies still indicate the existence of the pro and contra of the correlation between investment growth is a proxy of income. The hypothesis to be verified statistically in this study is that investment in Indonesia has a positive influence to investment in Indonesia. Based on the background, so it needed a study to analyze the relationship between economic growth and investment in Indonesia using VAR.

Research Methods

The variables used in this study are GDP growth, investment growth, export growth, import growth and interest rate growth. The study period is from 1980 to 2016. Data obtained from World bank, Indonesia Investment Policy Board (BKPM), International Monetary Fund (IMF) and Bank Indonesia.

Vector autoregressions Analysis

Vector autoregressions (VAR) is a statistical model used to capture the linear interdependencies among multiple time series. VAR models generalize the univariate *autoregression* (AR) models by allowing for more than one evolving variable. All variables in a VAR are treated symmetrically in a structural sense (although the estimated quantitative response coefficients will not in general be the same); each

variable has an equation explaining its evolution based on its own lags and the lags of the other model variables. VAR modeling does not require as much knowledge about the forces influencing a variable as do structural models with simultaneous equations: The only prior knowledge required is a list of variables which can be hypothesized to affect each other.

VAR usually has no exogenous variables in the model. The advantages of the VAR analysis are: (1) The method is simple, researcher never worry to differentiate between endogenous variables, where the exogenous variables, (2) Estimates are simple, where the usual OLS method can be applied to each equation separately; (3) The forecast obtained using this method in many cases better than the results obtained using a simultaneous equations model complex ones. In addition, the VAR Analysis is also a very useful analytical tool, both in understanding the reciprocal relationship (interrelationship) between economic variables, as well as in the economic model of structure formation. To understand the VAR analysis, consider a simple system of two variables (the simple bivariate system) following Hadi (2003):

$$Y_t = a_{10} + a_{11} Y_{t-1} + a_{12} Z_{t-1} + a_{13} Y_{t-2} + a_{14} Z_{t-2} + e_{yt} \quad (1)$$

$$Z_t = a_{20} + a_{21} Y_{t-1} + a_{22} Z_{t-1} + a_{23} Y_{t-2} + a_{24} Z_{t-2} + e_{zt} \quad (2)$$

Where Y is PDB in t,
Z_t = investment in t;
Y_{t-n} is PDB in t-n;
Z_{t-n} is investment in t-n;
a_{10}, a_{20} = constant; and e_{yt}, e_{zt} = error term.

Two of the equation above shows that two observable economic variables, namely gross domestic product (GDP) and investment, influence each other. For example, GDP in year t (Y_t) is affected by GDP in the previous period (Y_{t-1} and Y_{t-2}), and the investment in the previous year (Z_{t-1} and Z_{t-2}). Similarly, investment in year t (Z_t) is affected by the investment in the previous year (Z_{t-1} and Z_{t-2}), and by GDP in the previous period (Y_{t-1} and Y_{t-2}).

In general, the VAR model with n endogenous variables can be written as follows:

$$Y_{1t} = \beta_{01} + \Sigma_{i=1}^{p} + \beta_{i1} Y_{1t-i} + \Sigma_{i=1}^{p} + \alpha_{i1} Y_{2t-i} + \ldots + \Sigma_{i=1}^{p} + \eta_{i1} Y_{nt-i} + e_{1t} \quad (3)$$

where Y = variable and p = length of inaction.

VAR model is due to the right of the equation consists only of variable inertia on the left so called autoregression. While the word vector because it deals with two or more variables in the model. VAR model is a model that uses regression equation of time series data.

This study will develop a model that has been done by Hadi (2003) and combine with studies that have been done by Samanun (1994) and also Effendi and Sumarno (2003). This model is based on a model of Solow and Denison were derived from a

production function of the growth of inputs to calculate the growth of output. Following the assumption of growth sources (sources of growth Assumption) introduced by Solow and Denison then estimate a model of foreign direct investment in this research are:

$$GGDP = \alpha + \beta_1 GINV + \beta_2 GEXP + \beta_3 GIMP + \beta_4 GINT + \varepsilon \quad (4)$$

where

GGDP is the real GDP growth in Indonesia in the period t as proxy of national income; *GINV* is the investment growth in Indonesia in the period t; *GEXP* is the export growth in Indonesia in the period t; *GIMP* is the growth of imports in Indonesia in the period t, *GINT* is the growth of interest rate in Indonesia and *å* is intercept

The hypothesis presented in this study are as follows:

1. Investment growth has a positive influence on economic growth. Economic growth in this study is a proxy of national income in Indonesia. The proposition of this hypothesis is based on studies that have been done Effendi and Sumantri (2003) which states that investment in Indonesia has a positive influence on economic
2. Export growth has a positive influence on economic growth. The proposition underlying this hypothesis is that the more export then be correlated positively to economic growth in this study is a proxy of the national income.
3. Import growth has a negative impact on economic growth. The more import, the more the flow of funds out of the country which in turn will reduce national income.
4. Interest rate has negative impact on economic growth.

Stationary Test Data (Unit Root Test)

In statistics, a unit root test tests whether a time series variable is non stationary using an autoregressive model. This article used stationary unit root test was first developed by the Dickey-Fuller (DF). Tests will be carried out by the method of stationary ADF (Augmented Dickey-Fuller) conform to the shape of the trend variable in it. The procedure for determining whether or not the data stationary by comparing the value of the ADF statistics with MacKinnon critical values of the statistical distribution. If the absolute value of the ADF statistic is greater than the critical value MacKinnon, the data showed stationary. If instead, the absolute value of ADF smaller than the critical value, the data is not stationary MacKinnon. Nevertheless, the differencing is done must be interpreted that research does not lose meaning. A stationary means that the has a fixed and stable, random error = 0, so that the model used does not have spurious regression(Stock and Watson, 2001).

The combination of the two series are not stationary, it will move in the same direction towards the long-term equilibrium and the differentiation between the two series will be constant. If so, the series is said to be mutually integrated. Cointegration tests in this study are based on the approach vector autoregressions

(VAR) Johansen. If the vector Xt is a vector of endogenous variables in the VAR with lag length p, then:

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + ... + A_p X_{t-p} + \beta Y_t + \varepsilon_t \quad (5)$$

Where Xt = vector of endogenous variables; Ap = parameters of matrix; åYt = vector from deterministic variable and åt is vector of innovations. VAR specification can be expressed in terms of first differences as follows (Stock and Watson, 2001):

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=j}^{p-1} \Gamma_i \Delta X_{t-1} + \beta Y_t + \varepsilon_t \quad (6)$$

where

$$\Pi = \sum_{i=1}^{p} A_i - I$$

$$\Gamma_i = -\sum_{j=j+1}^{p} A_j, \text{ and}$$

I = matrix identity

If there is no cointegration relationship, unrestricted VAR models can be applied. However, if there is a cointegration relationship between the series, Vector Error Correction Model (VECM) is used. The number of cointegration vectors is obtained by looking at the significance of Π, through two likelihood test.

$$maximum\ eigenvalue = \lambda \max = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (7)$$

where is the estimated value obtained from the eigenvalue estimate the Π matrix and T = number of observations. Next test is test terrace which measures the number of cointegration vectors in the data, using the testing cointegration rank matrix, is expressed as follows:

$$trace\ statistic = \lambda_{trace} = -T \sum_{i-r+1}^{n} \ln(1 - \hat{\lambda}_i) \quad (8)$$

where T = number of observation time; $\hat{\lambda}_i$ = eigenvalue estimates generated from the estimated matrix Π; r = rank which indicates number of cointegration vectors (Stock and Watson, 2001).

To determine the number of cointegration vectors then there are three cases to consider, namely: (1). If levels Π = 0, then there is no long-term information and VAR models in different first level (first difference) suitable representation, (2). If the level is full Π, then i_t is stationary VAR in levels and in first match different representations, and (3) If the level of Π is $0 < r < p$, then β i_t stationary though not stationary and forms of error correction is quite representative. By knowing the number of cointegration vectors r, there will be found the number of cointegration relationships between variables.

Analysis of Impulse Response and The Cholesky Decomposition

Impulse Response is one of the critical analysis of the VAR model. This analysis is to track the response of the endogenous variables in the VAR system because of the shock or a change in the disturbance variable (e). The effect of a standard deviation shock to the innovations present value and the future value of the endogenous variables observed model. Shock effect of a variable not only affects the variable itself but also transmitted to other variables through the dynamic structure of the VAR lag or structure. The Cholesky Decomposition or commonly referred to as the variance decomposition provides information about the variables that are relatively more important innovations in the VAR. Basically, this test is another method to describe dynamic systems contained in the VAR.

Result and Discussion

The results of the unit root test for the variables of economic growth shows the absolute value of ADF statistic (-5.100921) is greater than the critical value MacKinnon confidence level of 1% (-3.632900) so that it can be said that the change in national income shock is stationary (see Table 1). Testing for investment growth variable (INV) indicates that the variable has a value of absolute ADF statistic (-8.015007) is greater than the critical value MacKinnon confidence level of 1% (-3.632900) so that it can be said that the data changes on the level of investment is stationary level.

The results of the unit root tests for variable export growth suggests that export growth has ADF statistic absolute value (-6.703520) is greater than the critical value MacKinnon confidence level of 1% (-3.632900) so that it can be said that the data changes in exports was stationary at the level. Meanwhile, the unit root test results for the variable import growth has stated that ADF statistic

Table 1
The result of unit root test

Variable	*Unit root*	*Level*	*Level of significance*
GDP	-5.100921	1%	-3.632900
		5%	-2.948404
		10%	-2.612874
INV	-8.015007	1%	-3.632900
		5%	-2.948404
		10%	-2.612874
EXPORT	-6.703520	1%	-3.632900
		5%	-2.948404
		10%	-2.612874
IMPORT	-7.162335	1%	-3.632900
		5%	-2.948404
		10%	-2.612874
INTEREST RATE	-5.458852	1%	-3.632900
		5%	-2.948404
		10%	-2.612874

absolute value (-7.162335) is greater than the critical value MacKinnon confidence level of 1% (-3.632900) so that it can be said that the data changes in imports was stationary at the level. From these results it can be concluded that all the variables have already qualified for the unit root test can be performed on the estimate.

Lags Optimal of VAR

In establishing the VAR model, then it must be determined first early how much lag the best fit model. To determine the amount of lag that best fits the model, the criteria used are based on the Akaike Information Criterion value test (AIC) and the Schwarz Information Criterion (SIC), which produces the minimum value. VAR test results inaction can be seen in Table 2.

Table 2
Lag Optimal of VAR

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	130.6724	NA	4.24e-10	-7.392493	-7.168029	-7.315944
1	180.3439	81.81198*	1.01e-10*	-8.843761*	-7.496973*	-8.384468*
2	191.3491	14.88926	2.55e-10	-8.020533	-5.551420	-7.178494

The analysis showed that the SC and HQ in is at lag 0 and the value of LR, FPE, AIC, SC and HQ is at lag 1. The test results showed that the degree of slackness variables to be stationary is the lag 1. Partial relationship with the t-test for Indonesia is known to have five relationships between variables that pass the t-test. The variables that affect the speed of the other variables that are all just variables affecting national income investments in variable lag 1 and no other variables that affect each other. It can be used in the study of variables that will be used as a means of causality, between national income, investment, exports, imports and interest rates.

Impulse Response Function and Variance DecompositionTest

Test results impulse response function can be seen Figure 3. The calculations show that the change in investment initially responded positively to the second and subsequent years responded negatively to 3 and eventually to the point of equilibrium. Meanwhile, export changes initially responded negative responded by national income until year 7. Meanwhile, import changes initially positive response by the national income until year 2, but then responded negatively to year 3 and headed to the balance point in the year to 7. The calculation of interest rate show that the change in interest rate initially responded positively and headed to the balance point in the year to 7.

Variance decomposition separates the variation in the change of each variable shock to other variables in the model. Any changes in the model variables are assumed uncorrelated. Variance decomposition illustrates the magnitude of the effect of a variable contribution of changes in the other variables in the model.

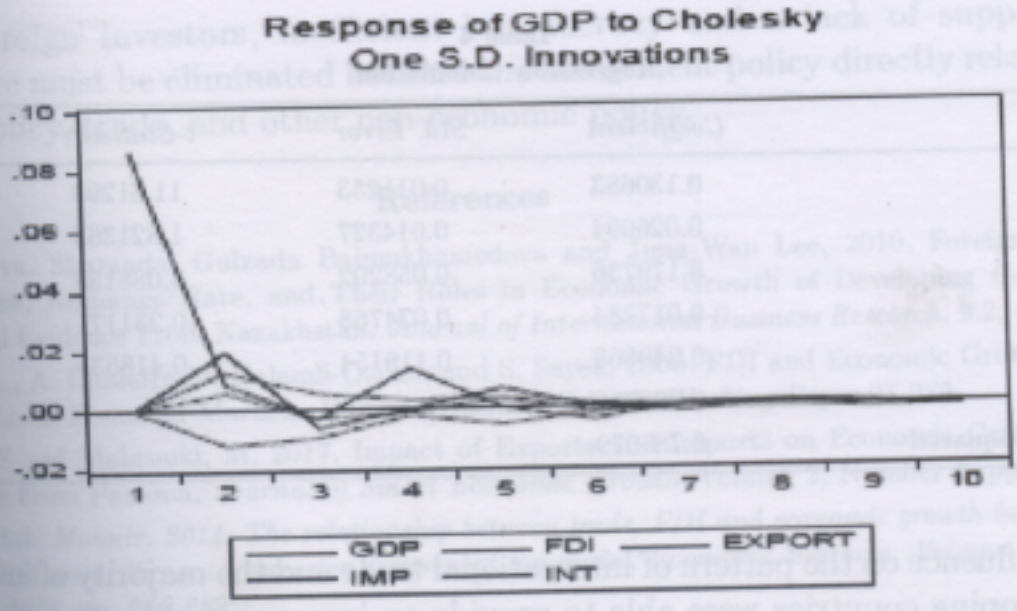


Figure 3: Response of investments, export, import and interest rate to national income

Table 3
The result of *Variance Decomposition*

Period	*S.E.*	*GDP*	*INV*	*EXP*	*IMP*	*INT*
1	0.086722	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.091080	91.54157	0.378883	1.700487	4.489498	1.889567
3	0.092045	89.74626	0.477994	2.731803	4.862755	2.181185
4	0.093088	89.79452	0.480500	2.739444	4.755868	2.229666
5	0.093575	88.86071	0.559911	3.076160	5.171254	2.331962
6	0.093709	88.82042	0.584233	3.100353	5.156969	2.338021
7	0.093726	88.79349	0.584134	3.099528	5.184976	2.337870
8	0.093740	88.77179	0.585985	3.100244	5.199536	2.342447
9	0.093752	88.77156	0.585941	3.100153	5.200329	2.342016
10	0.093755	88.76721	0.586218	3.100508	5.204189	2.341878

The results of the analysis states that the variance decomposition of the variables that explain national income in the period to the first affected by the variable itself is 100 percent. But starting the second period value continues to decrease until a period of 10 to 88.76 percent. Shock variable contribution of investment to national income is at first only 0,37 percent in the period to 2 and continue to increase period-10, up to 0,58 percent.

Regression Test Results

The results of regression testing is states that the growth of investment and export provides a positive and significant influence on economic growth in Indonesia. This means that the higher growth in exports and investment could increase economic growth. The results of calculations are presented in Table 4.

A positive result for export growth and FDI growth consistent with the hypothesis that has been proposed that export growth and FDI growth will drive economic growth. Several studies support the argument that the investment provides

Table 4
Regression Calculation

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob*
C	0.130683	0.011253	11.61298	0.0000
Investment	0.026094	0.014327	1.821363	0.0782
Export	0.179736	0.058202	3.088158	0.0042
Import	-0.017284	0.074768	-0.231171	0.8187
Interest rate	-0.049869	0.119154	-0.418531	0.6784
R-squared	0.808756			
Adjusted R-squared	0.784079			

a major influence on the pattern of international trade and the majority of investment into developing countries were able to provide an increase in exports.

According to the World Investment Report 2014, the general investment may increased exports by: (1) increase the domestic capital for exports, (2) transfer of technology and new products for export, (3) provide access to new markets or foreign markets; (4) provide training to the work force in the country to enhance the technical skills and management skills. The increase in exports was finally able to promote economic growth as measured by GDP growth of a country then affects the demand for money due to an increase in the GDP. Export is an important factor in stimulating the economic growth of a country. Exports and imports will increase the capacity of a country's consumption increased world output, as well as provide access to the resource-scarce resources and international markets with the potential to export products without which such products, the poor countries will not be able to develop activity and national economic life (Kholis, *et al*, 2016).

The research concludes that the growth of exports and investment growth will drive an economic growth. Investment is believed to be a major impact on the pattern of international trade and the majority of investment into developing countries were able to increase exports. Export is an important factor in stimulating the economic growth of a country as it will increase the capacity of a country to increase world output. Exports also can help all countries in take advantage of economies of scale that they have (Todaro and Smith, 2004).

Import growth has a negative influence but not significant to the economic growth in Indonesia. More imports by the state can lead to slower economic growth. These results support studies conducted by Saaed and Hussain (2015), Bellouniab (2014) and Bakari, and Mabrouki (2017). Meanwhile interest rates also have a negative but not significant influence on economic growth. The higher the interest rate will cause the investment will decrease which in turn will cause economic growth also slows down (see Jelilov, 2016). Therefore, Bank Indonesia as the central bank must maintain interest rate stability through monetary policy transmission.

Conclusion

Investment growth is a positive influence on economic growth in Indonesia. Thus, Indonesia should maintain the continuity of investment growth. Many barriers to

entry for foreign investors, inefficient bureaucracy and a lack of supporting infrastructure must be eliminated because the investment policy directly related to industrial policy, trade, and other non-economic policy.

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